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Abstract

**PRELIMINARY DEVELOPMENT OF DISPERSED FUELS
IN THE U.K.A.E.A.**

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1. This paper discusses the reasons for developing non-metallic dispersed ceramic fuels in the U.K. and their development status. Two systems have been chosen for detailed development: a dispersion of dense uranium dioxide in beryllia, and a dispersion of coated uranium carbide fuel in silicon carbide.
2. Sintering studies on commercially available BeO powders show that it is not possible to obtain consistently a high density product with high strength and low grain size. A route has therefore been developed to produce suitable powders for this purpose. It involves the precipitation of small crystallite size beryllium sulphate and its calcination under defined conditions. This and other powders have been characterised by physical methods; permeability studies have shed some light on the mechanism of sintering in BeO compacts.
3. Fuelled UO_2/BeO specimens are made by extruding a rod of the mixture simultaneously with a clad of pure BeO. After sintering, the exposed ends are sealed by hot pressing a disc of dense BeO on to them. Preliminary irradiations are being carried out on such specimens.
4. The neutron irradiation of dense pure BeO has been studied. Anisotropic expansion of the BeO lattice leads to the storing of strain energy in a polycrystalline material due to grain boundary constraint. At low irradiation

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temperatures and doses below about 5×10^{20} nvt at least, this strain energy can be estimated from X-ray lattice expansion data. At elevated temperatures or higher doses however, crystal growth due to irradiation-induced defect clusters may contribute appreciably to the strain energy.

5. Uranium carbide spheres for dispersion are made by granulating and spherodising a mixture of UO_2 and carbon powders followed by reaction sintering at controlled rates up to $1600^\circ C$. Spheres of UC of about 500 μ diameter and oxygen contents less than 0.2% have been made on the 10 kg scale. The particles are coated with pyrolytic carbon or silicon carbide in fluidised beds using methane or methyl-trichlorosilane and hydrogen. The effects of varying the reaction conditions on the quality of the coats are discussed.

6. Self-bonded silicon carbide rods are made by extruding a mixture of silicon carbide, carbon and a binder which is finally treated with molten silicon at $1,500^\circ C$. Dense rods (92-95% SiC; 8-5% Si) are produced and some of their physical properties are given.

7. Fuelled carbide rods are produced similarly, the fuel spheres being initially mixed with the other ingredients prior to extrusion. A fuel free layer and end-caps may be produced as in the case of BeO/UO_2 rods.

8. The irradiation of fuelled rods is in progress and irradiation results on unfuelled silicon carbide are discussed.